GPBR Exercise 6

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Matriculation Number: 22-132-245

1. First Zagreb Index: 40
   Narumi Simple Topological Index: 18
   Polarity Number: 1
   Wiener Index: 88.0
   Randic Index: 5.166666666666666
   Balaban-J Index: 46.49999999999999

2. Leading Eigenvalues: [-8.88178420e-16 2.02856483e-01]
   Eigen-mode Volumes: [1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.]
   Inter-mode Adjacency Matrix:
   [[-0.87309353 -0.04913514 0.14621881 0.18881727 -0.13048749 0.09481683
     -0.12532808 0.52480219 1.08044329 -0.50583916 0.11808845 0.3348249
      0.315707   -0.52495707]
    [-0.04913514 0.08409588 0.24917055 -0.04305821 -0.49385774 0.29070892
     -0.26443928 0.58098395 -0.14983877 0.22180233 -1.08013904 0.15309539
      0.40372162 0.47242856]
    [0.14621881 0.24917055 -0.33406804 0.20176115 -0.5155665   0.72492676
     -0.07572684 0.50137801 -0.66127547 0.04694891 -0.7625591 -0.03026924
     -0.16938124 -0.0921631]
    [0.18881727 -0.04305821 0.20176115 -0.31363746 -0.24685302 0.14535113
      0.0931408 -0.52393376 0.20959865 0.38452596 -0.14975412 -0.22764639
     -0.48632477 0.12584757]
    [-0.13048749 -0.49385774 -0.5155665 -0.24685302 -0.79688549 0.12533669
      0.4704523   0.47226197 1.544896   -0.32832189 0.33672553 -0.12492382
      0.05635106 -0.14704701]
    [0.09481683 0.29070892 0.72492676 0.14535113 0.12533669 -0.0628914
      0.81242186 0.19830826 -0.13108055 -0.3549715 -0.85485039 0.15245148
     -0.27203   0.63476058]
    [-0.12532808 -0.26443928 -0.07572684 0.0931408   0.4704523   0.81242186
      0.50698156 -0.12186043 1.41647906 0.62095822 -0.35421921 -0.32450348
     -0.64794913 0.29751257]
    [0.52480219 0.58098395 0.50137801 -0.52393376 0.47226197 0.19830826
     -0.12186043 0.45950792 0.12551497 -0.07756505 -0.6858474   0.32220734
      0.77074332 -1.04324263]
    [1.08044329 -0.14983877 -0.66127547 0.20959865 1.544896   -0.13108055
      1.41647906 0.12551497 1.64801922 -0.18452663 -0.55058295 -0.4422199
     -0.13909014 0.11860313]
    [-0.50583916 0.22180233 0.04694891 0.38452596 -0.32832189 -0.3549715
      0.62095822 -0.07756505 -0.18452663 -0.03518082 -0.31836388 0.04483708

```
  -0.47569848 -0.01452028]
 [ 0.11808845 -1.08013904 -0.7625591  -0.14975412  0.33672553 -0.85485039
  -0.35421921 -0.6858474  -0.55058295 -0.31836388  0.17055167 -0.52671645
  -0.31106471 -0.10271214]
 [ 0.3348249   0.15309539 -0.03026924 -0.22764639 -0.12492382  0.15245148
  -0.32450348  0.32220734 -0.4422199   0.04483708 -0.52671645 -1.0157973
   0.47733689  0.23140831]
 [ 0.315707    0.40372162 -0.16938124 -0.48632477  0.05635106 -0.27203
  -0.64794913  0.77074332 -0.13909014 -0.47569848 -0.31106471  0.47733689
   0.49799743 -0.99623403]
 [-0.52495707  0.47242856 -0.0921631   0.12584757 -0.14704701  0.63476058
   0.29751257 -1.04324263  0.11860313 -0.01452028 -0.10271214  0.23140831
  -0.99623403  0.06440035]]
```

3. Selected Prototypes: $\{0, 1, 2\}$

   Apply the Spanning Prototype Selector (SPS) with $n = 3$ to the given graph dataset $T = \{g1, g2, g3, g4, g5\}$ using the distance matrix D.

   We first initialize the set of prototypes P as an empty set. Then we find the median graph (graph with the median row sum of the distance matrix D) and add it to P. We remove the median graph from T (the set of remaining graphs). Next, we iteratively find the graph in T with the maximum minimum distance to the prototypes in P and add it to P. We repeat this process until we have n (in this case, 3) prototypes in P.

4. Pairwise Euclidean distances in the embedding space:
```
[[ 0.         1.73205081  4.35889894 11.04536102 17.05872211]
 [ 1.73205081 0.         3.46410162 11.53256259 17.54992877]
 [ 4.35889894 3.46410162 0.        10.04987562 17.20465053]
 [11.04536102 11.53256259 10.04987562 0.         9.        ]
 [17.05872211 17.54992877 17.20465053 9.         0.        ]]
```

   Absolute Differences:
```
[[0.        0.73205081 1.35889894 4.04536102 6.05872211]
 [0.73205081 0.        1.46410162 2.53256259 9.54992877]
 [1.35889894 1.46410162 0.        4.04987562 3.20465053]
 [4.04536102 2.53256259 4.04987562 0.        6.        ]
 [6.05872211 9.54992877 3.20465053 6.        0.        ]]
```